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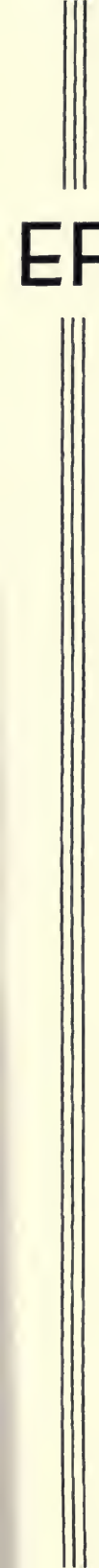
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EFFECT OF PASTURE ON GRADE OF BEEF

By SLEETER BULL,
R. R. SNAPP, and H. P. RUSK

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Effect of Pasture on Grade of Beef

By SLEETER BULL, R. R. SNAPP, and H. P. RUSK¹

PASTURE IS USED mainly in three ways in the production of market beef: (1) as the only feed; (2) as the only feed for a limited time, followed by full-feeding on pasture or in drylot; and (3) supplemented by grain, followed sometimes by drylot feeding. As more acres of forage and pasture become available under the soil-conservation programs, the use of pasture in beef production will probably increase. The effect of pasture on the grade and palatability of beef therefore becomes a question of increasing importance. At the present time grass-fed cattle consistently undersell grain-fed cattle, and cattle fed grain on pasture consistently undersell drylot cattle. The cattleman is much interested in knowing whether such discrimination is justified. The experiments reported herein throw light on this question.

The terms "market grade" and "palatability" are not synonymous. The grade of a carcass or cut is determined primarily by three factors: conformation, finish, and quality. It does not take into consideration the age of the animal and the degree of ripening (aging) attained before the carcass is eaten, both of which certainly affect the palatability of the beef. Also, considerable stress is laid upon the color of fat and lean in grading, yet in many instances the color of lean and of fat has no relation to the actual eating quality of the beef.

Conformation, as used in determining the grade of a carcass or cut, refers to the shape of the carcass, particular emphasis being placed upon compactness and a high development in the more expensive cuts, such as loin, ribs, and round. *Finish* refers to the amount and distribution of fat, with special emphasis upon the amount and character of marbling. *Quality* includes such factors as texture, firmness and color of lean, and firmness and color of fat.

The chart used by the U. S. Department of Agriculture and many state agricultural experiment stations (including the Illinois Station) in grading experimental beef carcasses is shown on page 228. A similar system is used by government graders in grading commercial beef, except for the following changes: (1) there is no class (sex)

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BEEF CARCASS GRADING CHART

Lot No. _____ Animal No. _____ Class _____		Date _____ Illinois Agricultural Experiment Station										Urbana, Illinois Grader _____										
		1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
CONFORMATION	Compactness		Very compact		Very compact		Compact		Mod. compact		Mod. compact		Sl. rangy		Rangy		Very rangy		Very rangy		Extremely rangy	
	Thickness of carcass		Very thick		Very large		Thick		Mod. thick		Mod. thick		Sl. thin		Thin		Very thin		Very thin		Extremely thin	
	Rib eye (lean)						Large		Mod. large		Mod. large		Sl. small		Small		Very small		Very small		Extremely small	
	Loin						Thick		Mod. thick		Mod. thick		Sl. thin		Thin		Very thin		Very thin		Extremely thin	
ROUND	Plump						Full		Mod. full		Mod. full		Sl. deficient		Deficient		Very deficient		Very deficient		Extrem. deficient	
	Thick						Thick		Mod. thick		Mod. thick		Sl. thin		Thin		Very thin		Very thin		Extremely thin	
FINISH	Thickness of fat (external)						Uniform		Mod. uniform		Mod. uniform		Sl. uneven		Uneven		Very uneven		Very uneven		Extrem. uneven	
	Distribution of fat (external)						Large amount		Mod. large amt.		Mod. large amt.		Sl. deficient		Deficient		Very deficient		Very deficient		Extrem. deficient	
	Kidney knob						Abundant		Mod. abundant		Mod. abundant		Sl. deficient		Deficient		Traces		Traces		None	
	Marbling (rib eye)						Fine		Mod. fine		Mod. fine		Sl. coarse		Coarse		Very coarse		Very coarse		Extremely coarse	
QUALITY	Grain of lean						Firm		Mod. firm		Mod. firm		Sl. soft		Soft		Watery		Watery		Gummy	
	Firmness of lean						V. light ch. red		Light cherry red		Light cherry red		Sl. dark ch. red		Mod. dark red		Dark red		Dark red		Dark red	
	Color of lean						Creamy white		Creamy		Creamy		Sl. yellow		Yellow		Very yellow		Very yellow		Fiery	
	Color of fat						Choice		Good		Good		Medium		Common		Cutter		Cutter		Low cutter	
	Grade						Prime		Prime		Prime		Medium		Common		Cutter		Cutter		Low cutter	

designation; (2) no cow may be graded higher than "Good"; (3) the term "Commercial" has been substituted for "Medium"; (4) "Utility" replaces "Common"; and (5) "Canner" replaces "Low Cutter."¹

PASTURE CATTLE IN DISREPUTE

When the cattle buyer makes his bid on a drove, he has in mind three points: (1) the amount of salable meat (dressing percentage, including shrinkage in the coolers before the carcass is sold); (2) the desirability of the meat (grade of the carcass); and (3) the market price of beef of the different grades.

Discriminated against by buyers. The packer-buyer assumes that grass steers dress lower in slaughter, shrink more in the cooler, and produce carcasses of lower grade than grain-fed steers. The cattle which have had nothing but grass are presumed to dress less because they contain less fat yet have the same amount of hide and other offal; their carcasses are supposed to shrink more in the cooler because they contain more water and have less protective fat covering; and their carcasses grade lower because they lack finish and have less desirable color.

In general it is true that grass cattle (cattle given no grain) produce carcasses that grade no higher than Medium, regardless of how well bred the cattle may be, primarily because of lack of finish. There are exceptions, however, to this generalization. In certain limited bluegrass areas in the United States cattle grading Good are produced with no grain, presumably because of the richness of the grass. Argentina, which is reputed to possess the best commercial breeding herds in the world, produces much Good and Choice beef upon alfalfa pasture alone. It has its own peculiar method of pasture management; alfalfa is grazed the year around, and it is customary to regulate the closeness of grazing by moving the cattle from field to field. Perhaps a similar system in this country would produce better beef than is now produced here on pasture.

Dark lean and yellow fat charged to pasture. Pasture is accused of producing dark lean and yellow fat. This is a serious charge, since the color of both lean and fat of beef is of major importance in determining the market grade of the carcass and consequently the price paid for the live cattle. Both the packer and the retailer, who reflect the views of the consumer, seriously discriminate against off colors.

¹Federal beef grading. Agricultural Marketing Service. U. S. Dept. Agr. Misc. Pub. 391. 1940.

The lean of beef should be a light cherry-red or pink. A dark or purplish red or a black is particularly objectionable to the housewife. Presumably this is due to two reasons: (1) the lean becomes darker with increasing age, and the housewife associates a dark color with the tough, stringy meat ordinarily produced by cattle of advanced age; (2) when beef is first cut, it is quite dark but immediately begins to brighten in color, reaching a maximum brightness in about one hour, then it slowly darkens and in several days becomes quite dark. Most retailers cut considerable amounts of steaks, roasts, etc., for display in showcases and for convenience during rush hours. Some of these cuts may be held too long before sold and become dark, dried out, and less palatable because they absorb undesirable flavors from the showcase or refrigerator. Consequently the housewife may associate dark beef with the dry, unpalatable steaks which have been cut too long.

Market grade lowered by dark lean. In a survey made in the summer of 1939 among several hundred housewives in Decatur, Illinois, less than 10 percent of the women interviewed preferred beef with a dark-red color.¹ As a result of such discrimination by consumers, the grade and the wholesale price of beef is distinctly lowered by dark lean.

In a study made in cooperation with the National Live Stock and Meat Board of the carcasses of 308 4-H Club calves shown at the 1938 International Livestock Exposition in Chicago, 55 carcasses were found in which the lean was more or less dark. The market grade of 7 of these carcasses was lowered three grades because of the dark lean (the grade after ribbing was lower than the grade assigned before the dark lean was discovered); the grade of 6 carcasses was lowered two grades; and the grade of the other 42 carcasses was lowered one grade. The reduction in market value due to dark lean is even more significant than the reduction in market grade. The value of the 7 carcasses was \$3 a hundred less because of their dark color, the value of the 6 carcasses was \$2 a hundred less, and the value of the 42 carcasses was \$1 a hundred less. The packers received \$490.34 less for these 55 carcasses than they would have received if the lean had not been dark.¹

Yellow fat objectionable in beef trade. Graders prefer beef fat to be white or creamy white, probably because certain breeds of dairy cattle and most scrub cattle have yellow fat and because as cattle become older there is a material increase in the amount of yellow pigment in their fat. Yellow fat, therefore, is an indication of inferior

¹Unpublished data.

breeding and of advanced age, and many housewives associate yellow fat with the tough, stringy, unpalatable meat of the worn-out dairy cow.

Apparently consumers object less to yellow fat than to dark lean. In the Decatur survey previously noted 55 percent of the housewives with incomes under \$100 a month, 35 percent of those with incomes of \$100 to \$200 a month, and 21 percent of those with incomes above \$300 a month actually preferred yellow to white fat on beef "because it looks richer."¹ Unfortunately there are no exact data showing the decrease in market value of beef due to yellow fat. It is probably considerably less than the decrease due to dark lean.

While most dark beef and most yellow beef rightfully belong in the lower grades, color alone does not determine eating quality. The meat from a steer which has yellow fat and purple lean but otherwise grades as Choice is equal in palatability to that from his white-fatted and red-meated brother of similar grade. This statement is based upon the results of a large number of palatability tests made by the U. S. Department of Agriculture and several experiment stations, including the Illinois Station.

EXPERIMENTS AT OTHER STATIONS

Colorado experiments on alfalfa and mixed pasture. Three lots of Hereford steers which averaged 650 pounds at the beginning of the experiment were fed at the Colorado Experiment Station.² Each lot was fed 5 pounds of ground barley and corn daily, but one lot was fed alfalfa hay in drylot, another was fed on alfalfa pasture, and the third lot was fed on mixed pasture.

The steers kept in drylot gained most rapidly, graded highest both as slaughter cattle and as carcasses, had the whitest fat and the lightest lean, and were the fattest of the three groups. The three lots did not vary greatly in dressing percentage. There was little difference in the palatability of the roasted ribs, the greatest difference occurring in the fat flavor, the steers on the mixed pasture being the most desirable in this respect and the alfalfa-pasture steers the least desirable.

Bluestem experiments at Kansas Station. Four groups of three- and four-year-old range-bred Hereford steers at the Kansas Station³ were given the following feeds: bluestem pasture, bluestem followed

¹Unpublished data.

²In cooperation with the U. S. Department of Agriculture. *Reported in* Conference on cooperative meat investigations, report of review committee (1937), Vol. 1, Ref. 52. National Live Stock and Meat Board.

³Conference on cooperative meat investigations (cited above), Ref. 55.

by a light grain ration on pasture, bluestem plus a full feed of grain, and bluestem hay in drylot plus a full feed of grain. Dressing percentages varied from 54 percent for the cattle on pasture alone to 62 percent for the cattle full-fed on pasture. No excessive chilling shrink of the grass-fed cattle was observed. Bluestem pasture did not produce dark beef, the lean of the carcasses of all lots being a desirable red.

Color readings indicated that the carcasses of the drylot cattle were the whitest and contained the least amount of yellow pigment. The cattle kept on grass and receiving supplementary feed had less yellow in their fat than those grazed without grain. No clearly yellow fat was encountered in any of the lots. There was no marked difference in the palatability of the meat from the different lots.

At the same station¹ two lots of yearling Hereford steers were fed 150 days, one lot given corn, cottonseed meal, silage, and alfalfa hay in drylot, and the other lot given the same concentrates on bluestem pasture. The drylot cattle were slightly superior in dressing percentage, carcass grade, and finish. There was no difference in the color of lean or in the palatability of the roasted ribs.

Nebraska experiments. Three-year-old Hereford steers were grazed without grain at the Nebraska Station² for 146 days, after which one-third of them were slaughtered. The remaining steers were fed grain and alfalfa hay in drylot for 64 days. The steers slaughtered off grass dressed lower than the steers finished in drylot, had lower carcass grades and less finish, and their lean was darker. The palatability of the beef of the grass steers was somewhat lower, but the difference was not great.

West Virginia experiments. Much work has been done at the West Virginia Station, in cooperation with the U. S. Department of Agriculture, on the effect of grass on the quality of beef. In three different years³ three-year-old steers of Good grade were grazed on bluegrass pasture, part of them receiving a light grain supplement and the others no grain. The average amount of the concentrates varied from 6.5 to 8.5 pounds a steer daily. Steers of Medium grade were similarly treated. Feeder cattle of Good grade on pasture alone graded at the bottom of Good as slaughter cattle, while Good feeders on grass

¹In cooperation with the U. S. Department of Agriculture. Conference on cooperative meat investigations (previously cited), Ref. 56.

²In cooperation with the U. S. Department of Agriculture. Conference on cooperative meat investigations (previously cited), Ref. 59.

³Black, W. H., Warner, K. F., and Wilson, C. V. Beef production and quality as affected by grade of steer and feeding grain supplement on grass. U. S. Dept. Agr. Tech. Bul. 217. 1931.

and a light grain ration graded Good as slaughter cattle. The Medium feeder steers grazed without grain produced Medium slaughter steers, and those given the grain supplement in addition to the grass graded Medium+ as slaughter cattle. A higher dressing yield and fatter, more attractive, and more salable carcasses were obtained by supplementing the grass with a light grain ration. The rib eye of the grain-fed cattle was a little lighter red, and the meat was slightly more tender than that of the others.

In three other experiments at West Virginia¹ five lots of Good two-year-old feeder steers were fed in each experiment approximately as follows:² (1) grass only for 135 days; (2) grass for 56 days, followed by grass and concentrates (8.7 pounds) for 79 days; (3) grass and concentrates (8.1 pounds) for 135 days; (4) grass for 135 days, followed by concentrates (14.6 pounds) and grass for 56 days; and (5) grass for 135 days, followed by concentrates (15.1 pounds) and clover hay in drylot for 56 days.

Grass alone produced steers yielding Medium carcasses. Grass for 56 days followed by grain on grass produced high Medium carcasses, as did also grass with grain thruout the feeding period. Grass followed by grain, both on pasture and in drylot, produced low Good carcasses.

The steers kept on grass for 135 days and then given grain on grass dressed the highest (slightly but probably not significantly higher than the steers of the other lots receiving grain), and the grass steers dressed distinctly the lowest. The carcasses of steers grazed without grain had the least finish, and the carcasses of those finished in drylot had the most. There was no significant difference between lots in the color of the lean, but the fat of Lots 4 and 5 (finished on grain) was less yellow than that of the other lots. There was no significant difference in the palatability of the roasted ribs from the five lots.

In other experiments at West Virginia³ with two-year-old and three-year-old steers careful measurements of the color of the lean were made with the spectrophotometer. The color of the fat is not recorded in the results.

The lean of two-year-old steers kept exclusively on grass for 127

¹Black, W. H., Hiner, R. L., Burk, L. B., Alexander, L. M., and Wilson, C. V. Beef production and quality as affected by method of feeding supplements to steers on grass in the Appalachian region. U. S. Dept. Agr. Tech. Bul. 717. 1940.

²There were slight variations in the feeding procedure in different years of the tests.

³Longwell, J. H. Color of lean of beef as affected by grass and grain feeding. W. Va. Agr. Exp. Sta. Bul. 274. 1936.

days and then given grain and hay in drylot for 56 days had excellent color. This was also true of three-year-old steers kept exclusively on grass. There was no significant difference in the color of the lean of the following lots of two-year-old steers: (1) a lot grazed without grain for 56 days and then given grain on grass for 140 days; (2) a lot grazed without grain for 84 days and then given grain on grass for 112 days; and (3) a lot grazed without grain for 140 days and then given grain on grass for 56 days. In fact the average color of each of these three lots was excellent.

Comparisons were made of 130 two-year-old steers in three different years fed as follows: (1) grass alone for 140 days; (2) grain on grass for 140 days; (3) grass alone for 140 days, followed by grain on grass for 56 days; (4) grass alone for 140 days, followed by grain and hay in drylot for 56 days; and (5) grass alone for 56 days, followed by grain on grass for 84 days. There was no consistent difference in the color of the lean of the different lots.

The following conclusions were drawn from the West Virginia experiments:

"Grass as a feed was not found to produce dark lean in beef.

"The brightness of the lean of beef appears to be related directly to the degree of finish of the beef.

"Beef from grass-finished cattle can be expected to be as bright as beef from grain-finished cattle which show a comparable degree of finish."

Louisiana experiments. The Louisiana Station¹ during 1928-1931 fed yearling and two-year-old steers pasture only (largely white clover and Bermuda grass) and pasture plus a light ration of concentrates. Representatives of the U. S. Department of Agriculture graded most of the carcasses, and rib cuts from some of the carcasses were sent to the Bureau of Animal Industry laboratory at Beltsville, Maryland, for a detailed study of the meat.

The conclusion was that the feeding of grain on pasture improved the grade of the carcasses and the finish, color, texture, flavor, and tenderness of the meat.

Virginia experiments. At the Virginia Station² one lot of three-year-old steers was grazed without grain; another lot was fed grain and cottonseed meal on grass; and a third lot was grazed without grain and was then fed for 60 days in drylot. The steers fed in drylot

¹Bray, C. I. Fattening steers of different ages on pasture, with and without grain, and influence of method on quality of meat. La. Agr. Exp. Sta. Bul. 296. 1938.

²In cooperation with the U. S. Department of Agriculture. Conference on cooperative meat investigations (previously cited), Ref. 61.

after having been kept exclusively on grass dressed highest, and the steers receiving no grain dressed lowest. The carcasses of the steers finished in drylot graded Good—, and the others Medium +.

The lean of the steers finished in drylot was lightest, and the lean of the steers kept exclusively on pasture was darkest. The fat of the steers fed grain on pasture had the least yellow, while that of the steers finished in drylot had the most. In fat content of the ribs, the steers finished in drylot ranked highest and those kept exclusively on pasture ranked lowest. The roasted ribs of the steers finished in drylot were the most tender, and those of the steers fed grain on grass were the least tender.

In other experiments at Virginia¹ one lot of steers was run on pasture for 147 days; another lot had pasture and grain for 147 days; and a third lot had pasture for 56 days, followed by grain for 91 days. The steers receiving no grain dressed lowest and their carcasses graded lowest. There was little difference between the two lots of cattle that were fed grain. The carcasses of the cattle fed grain on pasture for the entire period were slightly fatter than those of the cattle kept exclusively on pasture for 56 days and then fed grain. Carcasses of the steers which had no grain showed considerably less finish. There was no significant difference in color of lean among these three lots. Rib roasts from the steers kept on pasture for 56 days and then fed grain were slightly more tender and the flavor of their lean was somewhat more desirable than the roasts from the other lots. Otherwise there was no difference in palatability.

In a report by the Bureau of Animal Industry in 1939, another experiment at the Virginia Station was described as follows:²

"In the first year of a cooperative study with the Virginia Agricultural Experiment Station and the Virginia State Division of Markets, to compare the effects of grass and of grain feeding on the quantity and quality of beef, high-grade three-year-old Hereford steers were fed to approximately the same degree of finish on bluegrass alone and on corn with cottonseed meal and mixed hay. The animals weighed approximately 900 pounds at the beginning of the experiment, were fed 168 days, and averaged more than 1,300 pounds each at the close of the feeding period. A comparison of the two groups showed no appreciable difference in dressing percentage, no difference in grade of carcasses, and a similar percentage of edible meat in the carcasses. Little difference was observed in palatability factors, after either 10 or 50 days of storage of the meat at a temperature of approximately 34° F. The fat of the grass-fed animals was slightly yellower and contained much more carotene, the chief source of vitamin A, than did the fat of the grain-fed cattle. In view of the discrimination often suffered on the market by beef from grass-fattened cattle, these results are of particular interest."

¹Conference on cooperative meat investigations (previously cited), Ref. 62.

²U. S. Dept. Agr. Bur. Anim. Indus. Rpt., 1939, p. 10.

North Dakota experiments on dry, short pasture. It was found in experiments at the North Dakota Station in 1934¹ that steers grazed on dry short range pasture ate much vegetation they would ordinarily reject or eat sparingly. This feeding was believed responsible for a very intense and undesirable odor in the roasted ribs.

EXPERIMENTS AT THE ILLINOIS STATION

Full-Feeding Calves in Drylot Compared With Full-Feeding on Bluegrass Pasture

The somewhat uncommon use made of pasture in this experiment was suggested by the experience of some of Illinois' most successful fitters of steers for the carlot classes at the International Livestock Exposition in Chicago. One prominent Illinois feeder starts his calves on feed on bluegrass pasture during the early winter and allows them access to pasture until April 1, after which they are confined to drylot, where they are finished for the fall market or the carlot shows. Another successful showman starts his cattle in much the same way but continues them on pasture thru the summer. Both men report that the use of winter pasture results in larger and cheaper gains and enables them to handle more calves with their available equipment.

1933-1934 experiments. Twenty head of choice Hereford steer calves were started on feed December 22, 1933, on a 5-acre bluegrass pasture. This pasture had not been used during the 1933 grazing season and had a very heavy covering of mature bluegrass. During the winter the calves received a full feed of corn and half as much silage and hay as similar cattle fed in drylot. On April 13, 1934, 10 of these steers were taken from pasture and fed in drylot; the other 10 were continued on the 5-acre bluegrass pasture, and the hay and silage were gradually withdrawn as new grass became available. Another lot of 15 calves was full-fed in drylot.

The experiment was terminated July 30, 1934, and the cattle were slaughtered in New York. The data are given in Table 1.

Appraised value.—The valuation committee composed of market buyers and commission men valued the lot started on pasture and finished in drylot 85 cents a hundredweight over the other two lots, which were appraised at the same price.

Dressing percentage.—There was no significant difference in dressing percentage between the three lots.

¹Conference on cooperative meat investigations (previously cited), Ref. 60.

TABLE 1.—VALUE OF BLUEGRASS PASTURE IN FATTENING BEEF CALVES: 1933-34
December 22, 1933–July 30, 1934

	Lot 7 Full-fed in drylot	Lot 10 Full-fed on pasture until Apr. 13. Full-fed in drylot Apr. 13–July 30	Lot 11 Full-fed on pasture entire period
Number of calves.....	15	10	10
Total days on pasture.....	...	112	220
Total days in experiment.....	220	220	220
	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
Initial weight.....	436	441	436
Final weight.....	904	965	967
Average daily gain.....	2.13	2.38	2.41
Feed for 100 pounds gain			
Shelled corn.....	487	520	538
Soybean oilmeal.....	70	74	73
Corn silage.....	328	209	95
Alfalfa hay.....	94	62	24
Feed cost for 100 pounds gain ^a	\$6.05	\$6.20	\$6.21
Estimated value per cwt. in lot ^b	7.65	8.50	7.65
Return per steer above cost of cattle and feed..	17.01	25.43	17.18
Dressing percentage.....	60.4	60.9	60.3
Carcass grades.....	2 Choice + 7 Choice 4 Choice – 2 Good +	1 Prime 3 Choice + 5 Choice 1 Choice –	4 Choice 4 Choice – 2 Good +

^aFeed prices: shelled corn, 42 cents a bushel; corn silage, \$3.75 a ton; alfalfa hay, \$14 a ton; soybean oilmeal, \$32 a ton; pasture, \$6 an acre from December 22, 1933, to April 13, 1934, and \$4 an acre from April 13, 1934, to July 30, 1934.

^bEstimated Chicago value less 75 cents.

Carcass grades.—The pasture steers finished in drylot produced the best carcasses. The carcasses were graded by R. R. Snapp and a representative of the Bureau of Agricultural Economics, U. S. Department of Agriculture. The drylot steers (Lot 7) produced 2 Choice+, 7 Choice, 4 Choice–, and 2 Good+ carcasses. The color of fat of two carcasses of this lot was criticized; one was “a shade yellow,” the other “too creamy.” The steers started on pasture and finished in drylot (Lot 10) produced 1 Prime, 3 Choice+, 5 Choice, and 1 Choice– carcass. None was criticized as to color. Both the head cattle buyer and the head beef salesman of the packer who purchased the cattle stated that this was the best lot. The steers fed on pasture thruout the experiment (Lot 11) had 4 Choice, 4 Choice–, and 2 Good+ carcasses. Seven of these carcasses were faulted for being yellow, ranging from “slightly” to “bad.” These were not as well finished as the other cattle.

1935 experiments. The study on the use of bluegrass pasture in fattening beef calves begun in 1933-34 was continued, beginning Janu-

ary 25, 1935, with four lots of pasture-fed calves instead of only two, as in the first test. In addition to two lots fed grain on pasture during the winter (Lots 11A and 11B), there were two lots (Lots 6A and 6B) which were wintered in the drylot on corn silage, alfalfa hay, and 1 pound of soybean oilmeal, and which were turned onto pasture in the spring. One of these lots (Lot 6B) was full-fed shelled corn on pasture until fall; while the other (Lot 6A) was grazed without grain until midsummer and then full-fed in drylot. A fifth lot of calves (Lot 8) fed in the drylot during the entire feeding period served as a comparison for the calves fed on pasture. The results of the feeding test are given in Table 2.

Grain consumption.—The opinion that pasture effects a saving in the amount of grain needed to fatten a calf was not borne out by the results of either this or the previous year's experiment. In fact, the drove of calves fed continuously on pasture (Lot 11B) ate approximately 10 percent more corn per head than the calves fed continuously in drylot (Lot 8). The calves wintered on silage and hay, then grazed without grain until July 19 and afterwards full-fed in drylot until they weighed 1,000 pounds (Lot 6A) consumed 32 percent less corn than did the drylot calves in attaining the same weight. However, the saving effected on grain was largely offset by the cost of the much greater quantity of silage eaten and by the rental charged for the pasture area used by these cattle.

Sale price.—Most important of all, from a financial standpoint, was that the calves fed in drylot outsold the four lots on pasture from 35 cents to 75 cents a hundredweight despite the fact that all lots yielded almost the same percentage of carcass beef. In this particular test all four lots of pasture cattle would have returned less profit per head than the cattle fed in drylot even tho no charge whatever had been made for the pasture. Such was not the case in the test of the previous year.

Carcass grades.—The carcasses were graded by Sleeter Bull and two representatives of the Bureau of Agricultural Economics, U. S. Department of Agriculture. Since pasture is generally accused of being a cause of yellow fat, particular attention was given to this point (Table 2).

The carcasses of the drylot cattle graded highest and had a whiter fat than those of the pasture lots. The carcasses of the steers full-fed on bluegrass pasture for 228 days and of those full-fed on pasture for 91 days followed by 137 days in drylot graded about equally high, altho the fat of the latter lot was somewhat whiter. The carcasses of the lot which was wintered with no grain and then full-fed on pasture

TABLE 2.—VALUE OF BLUEGRASS PASTURE IN FATTENING BEEF CALVES: 1935
January 25–November 15

	Lot 8 Full-fed in drylot	Lot 6A No grain during winter. On pasture Apr. 26– July 19. Full-fed in drylot July 19– Nov. 15	Lot 6B No grain during winter. Full-fed on pasture Apr. 26– Sept. 10	Lot 11A Full-fed on pasture until Apr. 26. Full-fed in drylot Apr. 26– Sept. 10	Lot 11B Full-fed on pasture en- tire period
Number of calves.....	14	10	10	15	10
Total days on pasture...	...	84	137	91	228
Days fed grain.....	228	119	137	228	228
Date marketed.....	Sept. 16	Nov. 17	Sept. 16	Sept. 16	Sept. 16
Total days in experiment	228	294	228	228	228
	lb.	lb.	lb.	lb.	lb.
Initial weight.....	514	512	514	507	508
Final weight.....	1 005	1 002	959	983	1 010
Average daily gain.....	2.15	1.67	1.95	2.09	2.20
Feed for 100 pounds gain					
Shelled corn.....	525	359	455	537	588
Soybean oilmeal.....	75	65	80	78	79
Corn silage.....	332	629	522	279	100
Alfalfa hay.....	93	85	41	84	25
Limestone.....	4	4	5	5	4
Pasture, days.....	...	17	31	19	45
Feed cost for 100 pounds gain ^a	\$10.56	\$ 9.93	\$10.87	\$10.86	\$11.70
Estimated value per cwt. in lot ^b	11.00	10.25	10.55	10.45	10.65
Return per steer above cost of cattle and feed	27.34	22.84	21.45	20.10	17.84
Dressing percentage....	61.9	60.5	61.2	61.5	61.8
Carcass grades ^c	1 Prime 2 Prime – 5 Choice + 5 Choice 1 Good +	1 Choice + 1 Choice – 2 Choice – 1 No. 1 4 No. 2 1 No. 3	4 Choice 2 Choice – 4 Good +	1 Choice + 5 Choice 6 Choice – 2 Good + 1 Good	1 Choice + 2 Choice 6 Choice – 1 Good +
Color of fat ^c	12 creamy white 2 creamy	3 creamy white 1 fiery	10 creamy	7 creamy white 8 creamy	1 creamy white 9 creamy

^aFeed prices used in calculations: shelled corn, 80 cents a bushel; soybean oilmeal, \$40 a ton; corn silage, \$5.20 a ton; alfalfa hay, \$15 a ton; limestone, \$7.50 a ton; pasture, \$2 an acre for 28 days.

^bEstimated Chicago value less 75 cents.

^cBy mistake 6 carcasses of Lot 6A were shipped out before the grading committee saw them. They were graded by the packer graders as No. 1, No. 2, or No. 3. No grades for color of fat were obtained on these six carcasses.

for 137 days ranked next in grade, the fat being slightly yellow. The carcasses of the lot wintered with no grain, grazed on pasture for 84 days, and then full-fed in drylot for 119 days, graded the lowest. Unfortunately, due to an error, 6 carcasses of this lot were sold before the grading committee passed upon them. They were, however, graded by the packer's graders, who kept no record of the fat colors. Of the 4 carcasses graded by the committee, none had a yellow fat. This lot had a lower dressing percentage than the other lots.

1935-36 experiments. Three lots of grade Hereford steer calves of choice quality were fed from November 22, 1935, to August 31, 1936. Fourteen calves were full-fed in drylot a ration of shelled corn, soybean oilmeal, corn silage, and alfalfa hay (Lot 5). Nine similar calves (Lot 11A) were full-fed the same ration on bluegrass pasture to April 24, 1936, at which time they were placed in drylot where their feeding was continued. Ten similar calves (Lot 11B) were full-fed the same ration on bluegrass pasture to April 24, when the corn silage and alfalfa hay were withdrawn from the ration and the calves continued on full feed with bluegrass pasture as the only roughage. All three lots of cattle were marketed on August 31, 1936.

Hot and cold dressing percentages, cooler shrinks, killing fat, and

TABLE 3.—VALUE OF BLUEGRASS PASTURE IN FATTENING BEEF CALVES: 1935-36
November 22, 1935–August 31, 1936

	Lot 5 Full-fed in drylot	Lot 11A Full-fed on pas- ture until Apr. 24. Full-fed in drylot Apr. 24– Aug. 31	Lot 11B Full-fed on pasture entire period
Number of calves.....	14	9	10
Total days on pasture.....	...	154	283
Total days in experiment.....	283	283	283
	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
Initial weight.....	417	422	419
Final weight.....	978	998	1 048
Average daily gain.....	1.98	2.04	2.22
Feed for 100 pounds gain			
Shelled corn.....	472	495	467
Soybean oilmeal.....	68	72	68
Corn silage.....	346	252	127
Alfalfa hay.....	107	86	38
Limestone.....	5	5	5
Pasture, acre days.....	...	7.4	16.4
Feed cost for 100 pounds gain ^a	\$6.32	\$6.68	\$6.65
Estimated value per cwt. in lot ^b	8.40	8.50	8.50
Return per steer above cost of cattle and feed...	7.46	6.73	7.86
Dressing percentage.....	62.7	62.4	63.3
48-hour shrink in cooler, percent.....	1.4	1.4	1.4
Carcass grades.....	1 Prime 2 Choice + 3 Choice 3 Choice – 2 Good + 2 Good 1 Good –	3 Choice + 1 Choice 1 Choice – 2 Good + 2 Good	1 Choice + 2 Choice 3 Choice – 2 Good + 1 Good 1 Good –
Color of fat.....	5 white 6 creamy white 2 creamy 1 slightly yellow	1 creamy white 7 creamy 1 slightly yellow	1 creamy white 3 creamy 6 slightly yellow

^aFeed prices: corn, 50 cents a bushel; soybean oilmeal, \$25 a ton; corn silage, \$4.10 a ton; alfalfa hay, \$10 a ton; limestone, \$7 a ton; pasture, \$2 an acre per 28 days.

^bEstimated Chicago value less 75 cents.

carcass grades were obtained for the three lots of cattle. Particular attention was paid to the color of fat. The results are given in Table 3.

Dressing percentage.—Contrary to what general opinion would lead one to expect, the dressing percentage of the drylot cattle was not as high as that of the pasture cattle, perhaps because 1936 was a very dry season and the grass was dead and brown most of the summer.

Cooler shrink.—Also contrary to expectation based on general opinion, there was no difference between the three lots in the cooler shrink.

Carcass grades.—The carcasses of the drylot cattle graded somewhat higher than those of the grass cattle finished in drylot, and these in turn graded somewhat higher than those of the cattle fed on grass until the time of marketing.

Color of fat.—The color of the fat of the drylot cattle was decidedly superior to that of the other lots, altho the color of the fat of the grass cattle which were finished in drylot was not objectionable. The color of the fat of the cattle marketed off grass was decidedly inferior to that of either of the other lots. The cattle fed on grass were the fattest.

Alfalfa, Bluegrass, and Mixed Pasture Compared: Yearling Heifers

Sixty Choice yearling Hereford heifers purchased in Texas in the latter part of April were used in an experiment in 1934-35. Their average weight when they were put into the experimental lots on May 4 was 438 pounds. The four lots of 15 each into which the drove was divided were assigned to the following pastures:

Lot 1. Five acres of alfalfa seeded in 1932; pastured heavily by full-fed steers in 1933 but still showing almost a perfect stand in 1934.

Lot 2. Ten acres of mixed pasture seeded in 1933 to the following mixture per acre: bluegrass 10 pounds, bromegrass 15 pounds, redtop 7.5 pounds, white clover 5 pounds. Most of the seeding came up to a good stand, but extremely dry weather disposed of most of the white clover, which at first promised to be a very heavy stand. However, by early summer in 1934 bromegrass and volunteer sweet clover predominated. When it became apparent that the available forage exceeded the heifers' needs, grazing was restricted to 5 acres beginning June 29.

Lot 3. Five acres of an old alfalfa field in which bluegrass had been seeded the previous spring to replace the alfalfa which was dying out. The area allotted to the heifers was that half of the field containing the most bluegrass, which constituted 25 to 50 percent of the available forage in the grazed area. Beginning July 13 the heifers were given access to an additional 2½ acres from which two crops of alfalfa hay had been cut.

Lot 4. Ten acres of bluegrass seeded in 1929 and grazed rather close each season thereafter. Because of a cold dry spring, this pasture was in especially poor condition, and the heifers were not turned onto it until May 11.

The feeding of corn was begun in all lots on June 29 and continued at a uniform rate in all lots until the middle of September, when the failure of some of the heifers to clean up their grain properly made it impractical to keep all lots at the same feeding level during the last few weeks of the test. Cottonseed meal was added to the

TABLE 4.—COMPARISON OF DIFFERENT PASTURE MIXTURES FOR
YEARLING HEIFERS: 1934
May 4–September 28

	Lot 1 Alfalfa	Lot 2 Sweet clover and bromegrass	Lot 3 Alfalfa and bluegrass	Lot 4 Bluegrass
Number of heifers.....	15	15	15	15
	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
Initial weight.....	437	438	438	445
Final weight.....	678	723	714	694
Total gain.....	241	285	276	249
Average daily gain				
First 56 days, pasture only..	1.70	2.48	1.82	1.95 ^a
Last 91 days, pasture plus grain.....	1.60	1.61	1.91	1.69
Entire 147 days.....	1.64	1.94	1.88	1.78 ^a
Pasture per head	<i>acre</i>	<i>acre</i>	<i>acre</i>	<i>acre</i>
Lots 1 and 4, 147 days.....	.33	.....	.....	.67 ^a
Lot 2, 56 days.....	.....	.67	.....	.....
91 days.....	.....	.33	.....	.....
Lot 3, 70 days.....	.....	.....	.33	.....
77 days.....	.....	.....	.50	.....
Average daily grain ration for last 91 days	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
Shelled corn.....	8.6	9.0	8.5	8.5
Cottonseed meal.....	.8	.9	.8	.8
Feed for 100 pounds gain				
Shelled corn, pounds.....	325	288	281	329
Cottonseed meal, pounds...	32	28	27	32
Pasture, acres.....	.14	.16	.15	.29
Feed cost for 100 pounds gain ^b	\$5.43	\$4.74	\$4.46	\$5.81
Selling price per cwt. at Chicago ^c	6.05	6.25	6.25	6.15
Estimated return per head above cost of cattle and feed	-2.28	1.06	1.77	-2.57
Dressing percentage.....	58.4	58.4	57.3	57.7
Carcass grades.....	4 Good 4 Medium 1 Medium—	6 Good 3 Medium	3 Good 5 Medium	4 Good 4 Medium
Color of fat.....	1 creamy 7 slightly yellow 1 yellow	4 creamy 4 slightly yellow 1 yellow	2 slightly yellow 6 yellow	1 creamy 6 slightly yellow 1 yellow

^aLot 4 was turned onto pasture 7 days later than Lots 1, 2, and 3.

^bFeed prices: shelled corn, 60 cents a bushel; cottonseed meal, \$35 a ton; and pasture, alfalfa, \$10 an acre, bromegrass mixture, \$8 an acre, alfalfa-bluegrass, \$7 an acre, and bluegrass, \$6 an acre.

^cApproximately the top and bottom thirds of each lot were shipped to market, and the middle third was retained at the Experiment Station for further study and for slaughter.

ration on July 4 and gradually increased in amount until the heifers were receiving 1 pound of meal per head daily.

The feeding experiment was terminated on September 28. The heifers ranking approximately in the top and bottom thirds of each lot were shipped to Chicago and sold; while the middle third (6 heifers from each lot) were retained for further feeding and slaughter at the Experiment Station.

The results of the feeding experiment to September 28 and the slaughter data obtained on the heifers sold in Chicago are summarized in Table 4.

Color of fat.—Only 6 of the carcasses of the 34 pasture-fed heifers were rated as high as “creamy” in color of fat. The other 28 carcasses were either slightly yellow or distinctly yellow. The fact that the carcasses graded no higher than they did was due in considerable part to their color. The kind of pasture used appeared to have no relation to the color of fat.

The heifers retained at the Station were put in the drylot and given a full feed of corn, cottonseed meal, and alfalfa hay to determine, if possible, how long the yellow color of the fat would persist. The slaughter data for these cattle are given in Table 5.

On October 2, 4 days after removal from pasture, one heifer from each original lot was slaughtered. The carcasses graded Good— to Good+ but all were somewhat yellow. On October 18, 20 days after removal from pasture, another heifer from each lot was slaughtered. These carcasses graded Good— to Choice—, but they also were somewhat yellow. The carcasses of 4 heifers slaughtered October 25, after 27 days in the drylot, graded Medium+ to Choice—, but their fat was slightly yellow to yellow.

Four heifers slaughtered November 9, 42 days after removal from pasture, produced Good+ to Choice— carcasses. While their colors were better than those of the earlier killings, two of them were slightly yellow. Four more heifers were slaughtered November 22, 55 days off pasture. These carcasses were Good— to Choice— but two were slightly yellow. On January 24, 118 days off pasture, the remaining 4 heifers were slaughtered. The carcasses graded Good— to Choice—. All were slightly yellow.

Thus the yellow fat still persisted after 118 days of drylot feeding altho it was much less noticeable than when the heifers were removed from pasture in the early fall. The color of the lean meat of the heifers slaughtered immediately off pasture was excellent, as also was that of the heifers slaughtered after short periods of drylot feeding.

TABLE 5.—SLAUGHTER DATA ON PASTURE-FED HEIFERS FINISHED IN DRYLOT: 1935

Heifer No.	Date slaughtered	Days in drylot	Dressing percentage	Carcass grade	Color of fat	Color of lean*		
						Bright-ness	Wave length	Purity
Lot 1—Alfalfa								
50.....	10-2-34	4	57.5	Good —	Creamy	percl. 10.9	mμ 610	percl. 6
40.....	10-18-34	20	59.6	Good —	Creamy	15.5	610	15
42.....	10-25-34	27	59.1	Good +	Slightly yellow	14.1	608	13
37.....	11-9-34	42	57.3	Good +	Slightly yellow	14.0	607	20
41.....	11-22-34	55	58.4	Good +	Slightly yellow	14.1	640	10
34.....	1-24-35	118	57.7	Good —	Slightly yellow	13.9	615	19
Average...	.....	...	58.3	.....	.....	13.7	...	..
Lot 2—Sweet clover and brome-grass								
14.....	10-2-34	4	58.3	Good —	Yellow	13.5	620	10
15.....	10-18-34	20	59.5	Good +	Creamy	15.0	598	18
10.....	10-25-34	27	59.7	Good +	Slightly yellow	13.4	600	14
9.....	11-9-34	42	59.9	Choice —	Creamy	12.6	603	17
1.....	11-22-34	55	57.8	Good +	Creamy	11.6	650	5
5.....	1-24-35	118	60.6	Good +	Slightly yellow	13.6	700	0
Average...	.....	...	59.3	.....	.....	13.3	...	..
Lot 3—Alfalfa and bluegrass								
27.....	10-2-34	4	56.0	Good +	Creamy	15.0	635	13
24.....	10-18-34	20	57.6	Choice —	Slightly yellow	11.6	494C	15
23.....	10-25-34	27	58.5	Choice —	Slightly yellow	13.8	605	14
19.....	11-9-34	42	58.1	Good +	Creamy	12.8	700	0
22.....	11-22-34	55	59.0	Choice —	Creamy	14.6	620	12
26.....	1-24-35	118	61.7	Choice —	Slightly yellow	12.5	660	10
Average...	.....	...	58.5	.....	.....	13.4	...	..
Lot 4—Bluegrass								
61.....	10-2-34	4	57.3	Good —	Slightly yellow	14.4	615	8
54.....	10-18-34	20	56.8	Good	Slightly yellow	13.6	620	13
62.....	10-25-34	27	56.7	Medium +	Yellow	13.2	610	14
59.....	11-9-34	42	57.1	Good +	Slightly yellow	12.2	494C	16
67.....	11-22-34	55	53.3	Good —	Slightly yellow	12.9	630	5
28.....	1-24-35	118	60.1	Good +	Slightly yellow	12.4	620	15
Average...	.....	...	56.9	.....	.....	13.1	...	..

*Well-colored lean of yearling beef usually has a brightness of 13 to 16 percent, a wave length of 595 to 630 millimicrons, and a purity of 10 to 20 percent. See Bulletin 355 of this Station, pp. 219-225.

Sweet Clover, Alfalfa, and Brome-grass Compared: Yearling Steers

In the summer of 1935 a test was made comparing alfalfa, brome-grass, and second-year sweet clover, both for full-fed yearling steers

and for steers having pasture forage as their only feed. One group was full-fed in drylot to serve as a check. Seventy yearling steers in thin stocker condition obtained from the Kansas City market on May 1 were used for this test.

The alfalfa and brome-grass pastures were the same as those used in the experiment previously described. The alfalfa pasture was beginning to show the effects of heavy grazing, and there were thin spots where weeds had started to come in. In 1934 the brome-grass pastures contained a rather liberal volunteer stand of sweet clover. In 1935, however, there was practically no sweet clover in this field, but both bluegrass and redtop were beginning to appear.

The pasture designated as "sweet clover" was that resulting from the seeding of the following mixture in oats in the spring of 1934: sweet clover 8 pounds per acre, red clover 3 pounds, alsike clover 2 pounds, and timothy 5 pounds. On March 8, 1935, Korean lespedeza was seeded broadcast at the rate of 5.2 pounds per acre. However, fully 75 percent of the available forage until August 1 consisted of white-blossom sweet clover. The attempt to secure a stand of lespedeza in this field which would furnish grazing after the sweet clover had matured was unsuccessful. Practically all of the young lespedeza died out soon after germinating because of the dense shade made by the sweet clover.

Each pasture area consisted of 5 acres and was stocked with 12 steers where grain was fed and with 8 steers where the pasture forage constituted the entire ration. On June 21 one steer in Lot 6 (alfalfa without grain) died from bloat, reducing the number on that area to 7. A threatened shortage of grazing for this lot prompted the removal of 2 cattle on August 2, so that only 5 head were on this alfalfa pasture after that date. On the same day the steers on sweet clover without grain were transferred to a 5-acre field of lespedeza which had been seeded on cornstalk ground without a nurse crop, and the 12 grain-fed steers were given the run of both 5-acre sweet-clover fields.

The 12 steers fed grain on alfalfa pasture and the grain-fed and straight-pasture lots on brome-grass did not need any additional feeding area. In fact about an acre of the brome-grass field allotted to the grain-fed cattle was fenced off for another experiment, as the supply of forage was considerably more than these steers needed.

On September 23 all cattle were removed from pasture and put into the drylot. By this date all pastures had been grazed sufficiently close to make further grazing inadvisable from the standpoint of both

TABLE 6.—COMPARISON OF BROMEGRASS, ALFALFA, AND SWEET CLOVER FOR GROWING AND FATTENING YEARLING STEERS: 1935
May 6–November 15

	Pasture with grain			Drylot Lot 4	Pasture only		
	Lot 1 Bromegrass ^a	Lot 2 Alfalfa ^a	Lot 3 Sweet clover mixture ^b		Lot 5 Bromegrass	Lot 6 Alfalfa	Lot 7 Sweet clover and lespedeza ^c
Number of steers.....	12	12	12	10	8	7	8
Weight, May 6.....	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Weight, Sept. 23.....	549	547	574	543	546	544	569
Average daily gain, 140 days.....	865	888	878	926	744	846	810
	2.25	2.44	2.28	2.73	1.41	2.16	1.81
Weight, Nov. 15 ^d	1 001	997	988	996	Lots 5, 6, 7 fed together after Sept. 23		
Average daily gain, 53 days.....	2.57	2.36	2.27	1.70	.....	920 ^e	.....
Total gain, 193 days.....	452	466	424	473	.....	378	.....
Average daily gain, 193 days.....	2.34	2.42	2.28	2.45	.....	1.96	.....
Feed for 100 pounds gain							
Corn (shelled basis), pounds.....	459	442	487	577	.....	190	.....
Cottonseed meal, pounds.....	25	24	27	41	.....	14	.....
Legume hay, pounds.....	58	57	62	204	.....	73 ^a	.....
Pasture, acres.....	.09	.09	.14	.....	.....	.21	.....
Feed cost for 100 pounds gain ^f	\$ 7.79	\$ 7.55	\$ 8.62	\$ 9.79	.....	\$ 4.88	.....
Estimated value per cwt. in lots.....	9.25	9.50	9.50	10.25	.....	8.90	.....
Return above cost of cattle and feed.....	7.84	10.20	7.19	6.84	.....	13.89	.....
Feed saved per acre of pasture							
Corn, bushels.....	23.6	27.2	12.0	.....	.....	32.4	.....
Cottonseed meal, pounds.....	164	180	99	.....	.....	125	.....
Alfalfa, pounds.....	1 579	1 651	1 039	.....	.....	615	.....

^aPasture May 6 to September 23; drylot September 23 to November 15.

^bCattle turned onto sweet clover May 13.

^cThe November 15 average weights are for cattle remaining after representative steers had been returned to lespedeza August 2.

^dLots 5, 6, and 7 were regrouped on September 23 to compare soybean and lespedeza hay. The results shown are the average of the two lots.

^eFeed prices: corn, 75 cents a bushel; cottonseed meal, \$25 a ton; alfalfa, \$15 a ton; soybean hay, \$10 a ton; lespedeza, \$12 a ton; pasture, \$2 an acre per 28-day period.

^fEstimated Chicago value less 75 cents.

the cattle and the pastures. The steers which had received no grain and the two steers removed from the alfalfa pasture on August 2 were sorted into two lots to be used in a comparison of the feeding value of soybean hay and lespedeza hay. In this discussion, however, these cattle are considered as one lot for the drylot period.

Ground ear corn was fed on pasture because the cobs tend to reduce scouring and bloat on legume pasture. Shelled corn was fed to all lots of cattle after they were removed from pasture since shelled corn is considered better than ground ear corn for the latter part of the feeding period.

Representative steers were removed from each lot for slaughter on September 23, October 27, and at the close of the experiment on November 15, to permit a study of the effect of the different forages on the quality of beef. The 50 steers remaining were sold on the Chicago market on November 18.

A summary of the more important results of the feeding experiment appears in Table 6.

Gains.—From the standpoint both of total gains and of consistency of gains alfalfa proved to be much superior to either sweet-clover or brome-grass pasture for both grazed and grain-fed cattle. Altho the cattle on brome-grass and sweet clover made good gains during the first part of the summer, their gains fell off rapidly after the first two months. The steers on alfalfa, however, continued to make satisfactory gains until they were removed from pasture on September 23.

Plan of slaughter tests.—On September 24, the day following the removal of all lots from pasture, one steer from each lot was slaughtered. After 35 days of drylot feeding, a second steer from each lot was slaughtered; and after an additional 28 days a third steer from each lot was slaughtered. The following determinations were made for each animal: carcass grade; dressing percentage; shrink of carcass, wholesale ribs, retail ribs, and porterhouse steak; physical composition of wholesale ribs, as a measure of carcass condition; color of rib eye; color of fat covering; and percentages of water and fat in rib eye. A rib roast from each carcass was roasted by the standard method and the roasts scored on palatability by a committee of experienced judges. The carcass grades, dressing percentages, and colors of fat and of lean (as measured with the spectrophotometer) are given in Table 7.

Carcass grades.—The carcasses of the long-fed cattle graded higher than those of the steers on pasture alone and of the short-fed steers.

TABLE 7.—CARCASS DATA ON STEERS SLAUGHTERED AT URBANA: 1935 PASTURE EXPERIMENT

Steer No.	Ration	Carcass grade	Color of fat	Dressing percentage	Color of lean		
					Brightness	Wave length	Purity
Steers in first slaughter, September 24							
136	Full-fed, drylot ^a	Choice	Creamy white	58.3	percl.	m μ	percl.
109	Full-fed, alfalfa pasture.....	Choice —	Slightly yellow	57.3	14.2	610	18
108	Full-fed, sweet-clover pasture.....	Choice —	Creamy	58.5	15.0	611	19
145	Full-fed, bromegrass pasture.....	Good	Yellow	55.7	15.9	602	25
117	Alfalfa pasture.....	Medium +	Slightly yellow	56.8	11.9	493C	15
113	Sweet-clover-lepedeza pasture.....	Medium +	Slightly yellow	55.2	13.8	618	17
124	Bromegrass pasture.....	Medium —	Yellow	51.7	14.1	635	12
					15.2	603	23
Steers in second slaughter, October 28							
144	Long-fed, drylot ^a	Choice	Creamy white	60.3	16.3	608	20
150	Long-fed, alfalfa pasture, drylot ^a	Medium +	Yellow	58.8	13.6	615	15
122	Long-fed, sweet-clover pasture, drylot ^a	Good +	Slightly yellow	54.7	13.7	635	12
86	Long-fed, bromegrass pasture, drylot ^a	Choice —	Creamy white	58.5	14.3	635	23
112	Short-fed, alfalfa pasture, drylot ^b	Good +	Slightly yellow	56.3	12.9	625	10
96	Short-fed, alfalfa pasture, drylot ^c	Good —	Slightly yellow	56.7	14.7	625	14
Steers in third slaughter, November 25							
133	Long-fed, drylot ^a	Choice —	Creamy white	63.9	13.1	496C	15
114	Long-fed, alfalfa pasture, drylot ^a	Choice	Creamy	59.0	15.5	620	15
85	Long-fed, sweet-clover pasture, drylot ^a	Choice —	Slightly yellow	59.3	17.7	605	21
12	Long-fed, bromegrass pasture, drylot ^a	Choice —	Yellow	58.8	14.6	620	14
95	Short-fed, alfalfa pasture, drylot ^b	Medium +	Slightly yellow	58.0	17.4	615	15
123	Short-fed, alfalfa pasture, drylot ^c	Good —	Slightly yellow	57.7	15.6	635	11

^aThe roughage was alfalfa hay. ^bThe roughage was lepedeza hay. ^cThe roughage was soybean hay.

Color of fat and lean.—The fat of all the pasture carcasses ranged from yellow to creamy; that of the drylot steers was creamy white. The objectionable yellow color caused by pasture feeding had not disappeared after 63 days of drylot feeding. There were two "dark

TABLE 8.—SHRINKAGE OF CARCASSES AND CUTS:
1935 PASTURE EXPERIMENT

Steer No.	Ration	Carcass (10 days after slaughter)	Whole-sale rib cuts (5 days after cutting)	9th, 10th, and 11th ribs (6 days after cutting)	Porter-house steaks (6 days after cutting)
Steers in first slaughter, September 24					
		<i>percl.</i>	<i>percl.</i>	<i>percl.</i>	<i>percl.</i>
136	Full-fed, drylot.....	2.2	.7	2.1	5.4
109	Full-fed, alfalfa pasture.....	2.8	1.4	1.9	5.0
108	Full-fed, sweet-clover pasture.....	2.7	1.0	1.9	4.3
145	Full-fed, bromegrass pasture.....	3.4	1.9	2.4	6.5
117	Alfalfa pasture.....	2.7	1.9	2.4	5.5
113	Sweet-clover-lespedeza pasture.....	3.2	1.7	2.4	7.2
124	Bromegrass pasture.....	4.0	1.8	2.6	5.9
Steers in second slaughter, October 28					
144	Long-fed, drylot.....	2.7	1.5	2.6	4.9
150	Long-fed, alfalfa pasture, drylot.....	2.4	2.0	2.6	5.6
122	Long-fed, sweet-clover pasture, drylot.....	3.5	1.2	2.6	6.4
86	Long-fed, bromegrass pasture, drylot.....	3.6	1.4	2.6	4.8
112	Short-fed, alfalfa pasture, drylot.....	3.5	2.0	3.3	5.7
96	Short-fed, alfalfa pasture, drylot.....	3.1	1.7	2.5	5.6
Steers in third slaughter, November 25					
133	Long-fed, drylot.....	2.0	.8	1.7	4.8
114	Long-fed, alfalfa pasture, drylot.....	2.5	.8	2.7	4.0
85	Long-fed, sweet-clover pasture, drylot.....	2.1	1.3	2.1	4.8
12	Long-fed, bromegrass pasture, drylot.....	2.2	.7	1.6	6.7
95	Short-fed, alfalfa pasture, drylot.....	2.6	1.5	2.9	4.4
123	Short-fed, alfalfa pasture, drylot.....	2.5	1.3	2.0	6.2

cutters": No. 108, which was full-fed on sweet-clover pasture; and No. 133, full-fed in drylot. The lean of the other steers, including those which had had no grain while they were on pasture, had excellent color.

Carcass shrinkage.—The shrinkage of the carcasses 10 days after slaughter, of the wholesale rib cuts 5 days after cutting, and of the 9th, 10th, and 11th retail rib cuts and of the porterhouse steaks (cut short, 1 inch thick) 6 days after cutting are shown in Table 8. The prevalent idea that carcasses and cuts from pasture cattle shrink more than those from drylot cattle is not borne out by these results.

TABLE 9.—PHYSICAL COMPOSITION OF WHOLESALE RIBS AND CHEMICAL COMPOSITION OF RIB EYE: 1935 PASTURE EXPERIMENT

Steer No.	Ration	Wholesale rib cuts				Rib eye	
		Rib eye	Lean	Fat	Bone	Water	Fat
Steers in first slaughter, September 24							
		<i>percl.</i>	<i>percl.</i>	<i>percl.</i>	<i>percl.</i>	<i>percl.</i>	<i>percl.</i>
136	Full-fed, drylot.....	12.3	49.0	35.4	15.0	73.3	4.5
109	Full-fed, alfalfa pasture.....	15.0	53.5	32.9	14.4	73.6	2.5
108	Full-fed, sweet-clover pasture....	15.2	51.5	31.5	17.2	74.2	2.5
145	Full-fed, bromegrass pasture.....	17.7	56.2	24.4	19.3	75.2	1.9
117	Alfalfa pasture.....	15.0	51.7	28.8	19.3	74.8	2.3
113	Sweet-clover-lespedeza pasture...	17.7	59.3	21.3	18.7	75.0	1.5
124	Bromegrass pasture.....	17.0	56.6	19.4	22.8	75.3	1.7
Steers in second slaughter, October 28							
144	Long-fed, drylot.....	14.5	47.2	36.1	16.4	74.1	3.6
150	Long-fed, alfalfa pasture, drylot..	16.5	53.7	28.3	17.4	72.3	4.1
122	Long-fed, sweet-clover pasture, drylot.....	12.5	47.3	34.3	18.3	73.8	3.0
86	Long-fed, bromegrass pasture, drylot.....	13.8	44.7	35.1	19.8	74.1	3.6
112	Short-fed, alfalfa pasture, drylot	13.5	55.6	27.1	16.2	74.7	2.7
96	Short-fed, alfalfa pasture, drylot	14.1	53.2	23.4	23.0	73.3	3.3
Steers in third slaughter, November 25							
133	Long-fed, drylot.....	14.7	51.0	34.4	13.5	73.3	3.6
114	Long-fed, alfalfa pasture, drylot	12.1	47.7	38.2	13.8	72.4	4.8
85	Long-fed, sweet-clover pasture, drylot.....	13.4	47.9	37.5	14.3	72.0	5.5
12	Long-fed, bromegrass pasture, drylot.....	12.9	47.2	37.3	15.1	73.0	5.1
95	Short-fed, alfalfa pasture, drylot	16.3	52.8	30.0	17.0	74.7	2.6
123	Short-fed, alfalfa pasture, drylot	14.3	50.9	30.3	18.4	74.2	3.5

Composition of rib cuts and rib eyes.—The physical composition of the wholesale rib cuts and the chemical composition (water and fat) of the rib eyes are shown in Table 9. With percentage of fat (as separated with a knife) in the wholesale rib cut as a measure of condition,¹ and percentage of fat (as determined chemically) in the rib eye as a measure of marbling, it is to be noted that no significant differences were observed between the steers full-fed in drylot and those full-fed on pasture.

Physical characteristics of ribs.—The texture, marbling, and firmness of the rib eye and the color and firmness of the external fat of the 9th, 10th, and 11th rib cuts before cooking are shown in Table 10. Again there was no striking difference between the ribs of the full-fed drylot steers and those of the full-fed pasture steers except in color of

¹See Bulletin 355 of this Station, p. 210.

TABLE 10.—PHYSICAL CHARACTERISTICS OF RIBS AS PREPARED FOR COOKING: 1935 PASTURE EXPERIMENT

Steer No.	Ration	Texture of lean	Marbling	Firmness of lean	Color of fat	Firmness of fat
Steers in first slaughter, September 24						
136	Full-fed, drylot.....	Very fine	Plentiful	Firm	Creamy white	Very firm
109	Full-fed, alfalfa pasture.....	Fine	Moderate	Moderately firm	Slightly yellow	Firm
108	Full-fed, sweet-clover pasture.....	Slightly coarse	Moderate	Soft	Slightly yellow	Firm
145	Full-fed, bromegrass pasture.....	Slightly coarse	Traces	Very soft	Slightly yellow	Firm
117	Alfalfa pasture.....	Slightly coarse	Traces	Very soft	Slightly yellow	Moderately firm
113	Sweet-clover-lespedeza pasture.....	Fine	Traces	Soft	Yellow	Moderately firm
124	Bromegrass pasture.....					
Steers in second slaughter, October 28						
144	Long-fed, drylot.....	Very fine	Moderate	Moderately firm	Creamy white	Very firm
150	Long-fed, alfalfa pasture, drylot.....	Very fine	Plentiful	Moderately firm	Creamy white	Very firm
122	Long-fed, sweet-clover pasture, drylot.....	Slightly coarse	Moderate	Soft	Slightly yellow	Very firm
86	Long-fed, bromegrass pasture, drylot.....	Fine	Plentiful	Moderately firm	Slightly yellow	Very firm
112	Short-fed, alfalfa pasture, drylot.....	Fine	Traces	Very soft	Slightly yellow	Very firm
96	Short-fed, alfalfa pasture, drylot.....	Fine	Moderate	Soft	Slightly yellow	Very firm
Steers in third slaughter, November 25						
133	Long-fed, drylot.....	Fine	Moderate	Moderately firm	Creamy white	Very firm
114	Long-fed, alfalfa pasture, drylot.....	Fine	Plentiful	Moderately firm	Slightly yellow	Very firm
85	Long-fed, sweet-clover pasture, drylot.....	Fine	Moderate	Moderately firm	.....	Very firm
12	Long-fed, bromegrass pasture, drylot.....	Fine	Plentiful	Moderately firm	Slightly yellow	Very firm
95	Short-fed, alfalfa pasture, drylot.....	Slightly coarse	Traces	Soft	Slightly yellow	Very firm
123	Short-fed, alfalfa pasture, drylot.....	Fine	Moderate	Moderately firm	Slightly yellow	Very firm

fat, which has already been noted. The rib eyes of the steers which had pasture exclusively and of the steers which had a short grain feed following pasture were generally softer than those of the long-fed steers.

Cooking losses.—The 9th, 10th, and 11th ribs from one side of each carcass were roasted by members of the Home Economics Department

TABLE 11.—COOKING LOSSES FROM RIBS: 1935 PASTURE EXPERIMENT
(9th, 10th, and 11th ribs from one side of each carcass)

Steer No.	Ration	Evapora- tion	Drippings	Total loss
Steers in first slaughter, September 24				
		<i>perct.</i>	<i>perct.</i>	<i>perct.</i>
136	Full-fed, drylot.....	8.6	9.8	18.4
109	Full-fed, alfalfa pasture.....	7.8	7.4	15.2
108	Full-fed, sweet-clover pasture.....	9.3	7.9	17.2
145	Full-fed, bromegrass pasture.....	9.0	7.0	16.0
117	Alfalfa pasture.....	10.5	8.3	18.8
113	Sweet-clover-lespedeza pasture.....	10.5	6.2	16.7
124	Bromegrass pasture.....	10.1	5.3	15.4
Steers in second slaughter, October 28				
144	Long-fed, drylot.....	9.8	7.4	17.2
150	Long-fed, alfalfa pasture, drylot.....	10.2	8.7	18.9
122	Long-fed, sweet-clover pasture, drylot.....	9.1	9.3	18.4
86	Long-fed, bromegrass pasture, drylot.....	8.9	8.5	17.4
112	Short-fed, alfalfa pasture, drylot.....	8.5	5.7	14.2
96	Short-fed, alfalfa pasture, drylot.....	8.6	5.4	14.0
Steers in third slaughter, November 25				
133	Long-fed, drylot.....	6.3	9.1	15.4
114	Long-fed, alfalfa pasture, drylot.....	7.4	8.0	15.4
85	Long-fed, sweet-clover pasture, drylot.....	9.9	8.6	18.5
12	Long-fed, bromegrass pasture, drylot.....	9.3	10.6	19.9
95	Short-fed, alfalfa pasture, drylot.....	11.1	7.4	18.5
123	Short-fed, alfalfa pasture, drylot.....	8.0	7.6	15.6

of the University of Illinois by the method recommended by the "Conference of Cooperators in the Quality of Meat Projects."¹ The cooking losses are shown in Table 11.

The ribs from the steers in the first slaughter which had received no grain lost more by evaporation than those from the full-fed steers. In total cooking losses, however, there were no consistent differences. The ribs from the short-fed steers of the second slaughter lost considerably less from drippings and slightly less from evaporation than

¹Method of cooking and testing meat for palatability. U. S. Dept. Agr. (mimeo.), rev. Feb. 1933.

the ribs from the long-fed steers. The ribs from the short-fed steers of the third slaughter lost less by drippings than those from the long-fed steers, but there was no significant difference in total losses.

The ribs from the full-fed drylot steers and those from the full-fed pasture steers showed no significant differences in cooking losses.

Palatability.—The roasted ribs were scored for palatability by a committee of eight judges, all of whom were experienced in judging food products. From these scores each rib was ranked according to its palatability.

Of the ribs from the steers of the first slaughter, those from No. 109, full-fed on alfalfa pasture, were by far the best. Those from No. 136, full-fed in drylot, and No. 108, full-fed on sweet-clover, tied for second place. No. 113 (sweet-clover—lespedeza pasture with no grain) was fourth, closely followed by No. 117 (alfalfa pasture, no grain) and No. 145 (full-fed on bromegrass). No. 124 (bromegrass, no grain) was distinctly last. One judge criticized the flavor of the lean of No. 124 as "abnormal" and "slightly undesirable."

Of the ribs from the second kill, those from No. 86 (long-fed on bromegrass pasture followed by drylot) were most palatable, closely followed by those from No. 96 (alfalfa pasture, short-fed in drylot) and No. 144 (full-fed in drylot). No. 112 (alfalfa pasture, short-fed in drylot) and No. 122 (long-fed on sweet-clover pasture, followed by drylot) were practically a tie for fourth place. No. 150 (long-fed on alfalfa pasture, followed by drylot) was last. In spite of the high rating which No. 96 received, four of the judges criticized it as having an off flavor which was described by two judges as "fishy." No. 112, which also had received only alfalfa pasture prior to drylot feeding, was criticized by three of the judges for a "fishy" flavor. No. 150 was criticized by two judges for an "abnormal" flavor.

The palatability ranking of the ribs from the third slaughter was: No. 114 (full-fed on alfalfa pasture, followed by drylot), first; No. 12 (full-fed on bromegrass, followed by drylot), second; No. 85 (full-fed on sweet clover, followed by drylot), a close third; No. 95 (alfalfa pasture, followed by short feed in drylot), a close fourth; No. 123 (alfalfa pasture, followed by short feed in drylot), fifth; and No. 133 (full-fed in drylot), a poor sixth. One judge said No. 95 had a "fishy" flavor. Six judges detected an "abnormal" flavor in No. 123, which four of them described as "fishy." Three judges severely criticized the flavor of No. 133.

The results of the palatability tests show conclusively that the ribs from cattle full-fed in drylot were not superior to those from cattle

full-fed on pasture. There was some indication that alfalfa pasture, with no grain, followed by feeding in drylot produced fishy flavors.

Market grades.—The other 50 steers in this test were shipped to Chicago on November 15. Their carcasses were graded in the packer's cooler by representatives of the packer, the U. S. Department of Agriculture, and the Experiment Station. Unfortunately some of the carcasses were sold by the packer before they were seen by the graders of the Department of Agriculture and the Experiment Station. They were, however, graded by packer graders, but the colors of the fat were not recorded. The grades, dressing percentages, and carcass grades obtained from the grading in Chicago are given in Table 12.

The steers full-fed in drylot dressed higher and produced higher-grade carcasses than the steers full-fed on pasture and then finished in drylot. The fat of the pasture steers was generally somewhat yellow in contrast to the creamy-white fat of the drylot steers. The objectionable yellow color had not entirely disappeared after 53 days of drylot feeding. The fat of the carcasses from the steers fed on sweet-clover pasture had less yellow than that from the other pasture lots.

TABLE 12.—MARKET AND CARCASS DATA ON STEERS SLAUGHTERED AT CHICAGO: 1935 PASTURE EXPERIMENT

Ration	Government grades	Packer grades of "lost" carcasses ^a	Color of fat	Dressing percentage	Selling price per cwt.
Long-fed, drylot ^b	1 Choice + 3 Choice 1 Good +	1 No. 1 1 No. 2	4 creamy white 1 slightly yellow	62.8	\$11.00
Long-fed, alfalfa pasture, drylot ^b . .	2 Choice 1 Choice - 3 Good +	2 No. 2 1 No. 3 +	2 creamy white 4 slightly yellow	60.0	10.25
Long-fed, sweet-clover pasture, drylot ^b	1 Choice 3 Choice - 1 Good + 1 Good 1 Good -	2 No. 1	5 creamy white 2 slightly yellow	60.6	10.25
Long-fed, bromegrass pasture, drylot ^b	1 Choice 2 Choice - 2 Good + 1 Good 2 Good -	1 No. 2	2 creamy white 6 slightly yellow	59.4	10.00
Short-fed, pasture, drylot ^c	1 Good + 1 Good	1 No. 3 5 No. 4	2 slightly yellow	57.6	9.65
Short-fed, pasture, drylot ^d	1 Good 3 Good - 1 Medium	2 No. 3 + 1 No. 4	5 slightly yellow	56.4	9.65

^aSome carcasses were sold before they were graded by the government graders. They were graded by the packer graders only, and the color of the fat was not recorded. ^bRoughage was alfalfa hay. ^cRoughage was lespedeza hay. ^dRoughage was soybean hay.

As would be expected, the carcasses of the steers having only pasture until they were removed to drylot on September 23 graded lower and were yellower than those of the steers full-fed on pasture.

SUMMARY AND CONCLUSIONS

Beef from pasture cattle has long been thought to be inferior to beef from drylot cattle. In order to determine whether this discrimination is based on fact or on prejudice, several of the agricultural experiment stations and the U. S. Department of Agriculture have made extensive feeding tests. Experiments conducted at the Illinois Station from 1933 to 1936 are reported herein. In one experiment steer calves full-fed in drylot were compared with calves full-fed on pasture. Dressing percentage, carcass grade, and color of fat were determined for each calf. For some, cooler shrink was also determined.

In another Illinois experiment yearling heifers were kept on various pastures for 56 days and then full-fed on pasture for 91 days. Some of the heifers were marketed and the slaughter data obtained. The others were put in drylot and slaughtered after 4, 20, 27, 42, 55, and 118 days of grain feeding in an effort to determine how long the yellow color of their fat would persist. Slaughter data were obtained, and the color of the rib eye was measured with a spectrophotometer.

In a third experiment a lot of yearling steers was full-fed in drylot, three lots were full-fed on various pastures, and three lots grazed without grain. Representative steers were slaughtered after 140 days. The others were transferred to the drylot. Some were slaughtered after 35 days and after 63 days of full-feeding in the drylot. Dressing percentage, carcass grade, shrink of carcass and certain cuts, physical composition of ribs, color of rib eye, and percentage of fat and of water in the rib eye were ascertained for each. The ribs of each steer were tested for palatability. The rest of the steers were slaughtered in Chicago and carcass grades and dressing percentages obtained.

From the results of these experiments and the experiments at other stations reported herein, the following conclusions seem justified.

Cattle Fattened Exclusively on Pasture

1. Because of their lower finish, pasture cattle dress materially lower than cattle fattened on grain and pasture or on grain and roughage in drylot.
2. Because of a lower fat content and a higher water content, the carcasses of pasture cattle shrink more in the cooler than the carcasses of cattle full-fed in drylot.

3. There is more or less yellow in the fat of the carcasses of pasture cattle because of the transfer of carotene from pasture to body fat.

4. At best the carcasses of such cattle usually grade no higher than Medium because of yellow fat and lack of finish.

5. The meat of such cattle has inferior eating qualities because of lack of finish.

6. Well-bred cattle fattened on good pasture do not produce dark lean.

Cattle Full-Fed Grain on Pasture

1. Cattle full-fed grain on pasture dress as high as drylot cattle of similar finish.

2. Their carcasses shrink no more than those of drylot cattle of similar finish.

3. There is more or less yellow in the fat of such cattle but the lean is not dark.

4. Because of the yellow fat, the carcasses of these cattle grade somewhat lower than carcasses of similar cattle with the same degree of finish fed in drylot.

5. The meat from such cattle is as palatable as that from drylot cattle of equal carcass grade.

6. The price penalty imposed upon cattle which have been full-fed grain on pasture is frequently not justified.

7. Yellow fat is not so objectionable to consumers as has been thought in the meat trade.

Cattle Finished in Drylot

The same conclusions apply to the carcasses of cattle which have run on pasture with or without grain and then finished in drylot as have been stated for cattle finished on grain and pasture, except that the carcasses of cattle finished in drylot grade a little higher because of less yellow in the fat. They grade slightly under those of drylot cattle because of lower finish and because this yellow color is not removed but is only diluted by finishing in drylot.

Application of Findings to Beef Grading

The results of these experiments indicate that the idea of all packers, most retailers, and many consumers that all beef which has a yellow tinge in its fat is inferior in palatability should be altered by an educational campaign by the livestock and meat industry, and less emphasis should be placed upon color of fat in beef grading.

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